Foundations

ENERGY STAR® Requirements

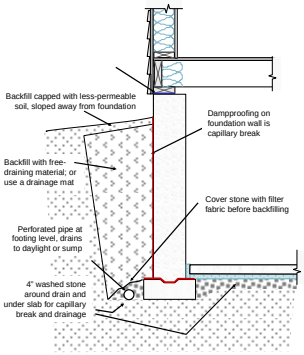
There are no specific requirements for foundation <u>construction</u> in the Northwest ENERGY STAR® Homes program

• Basements used as conditioned space must have R-19 wall insulation

• Slabs in heated space must have R-15 rigid insulation 2' vertical or horizontal along the slab edge

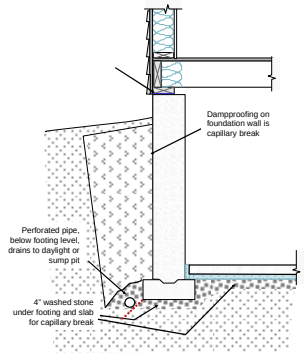
Foundation Water Control

- Control flow of rain and ground water
- Control capillary flow
- Control vapor diffusion



Foundation Water Control

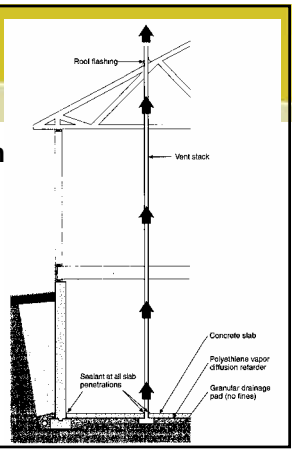
- Better:
- Add drainage/cap break *under footing*
- Important
  - Washed, uniform sized stone
  - Drain pipe outside 45º from footing corner



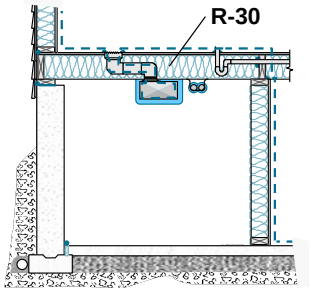
Soil Gas Vent System

- Stack effect or added fan vents soil gases outdoors
- Relieves negative pressure between slab and basement

From EEBA Cold Climate Builder's Guide, Fig 4.5

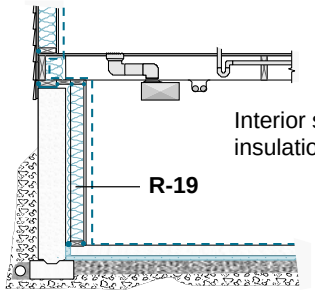


Insulation Options



Insulated floor over unheated basement, crawlspace or garage

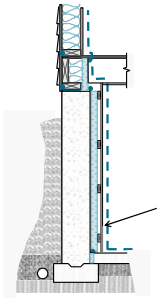
Insulation Options



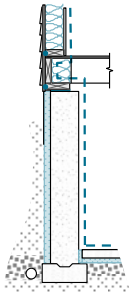
DON'T DO THIS!!!

Poly on inside of foundation wall!

Insulation Options



Insulation Options



What sometimes happens…

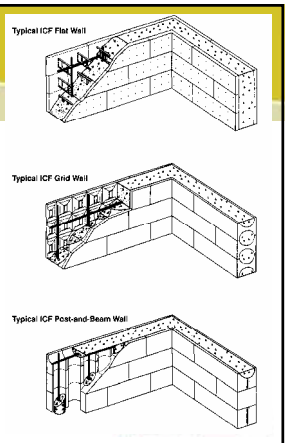
Detailing Vented Crawl Spaces

- Impeccable ground cover
  - Sealed at seams and edges
- Insulation touching subfloor
- Seal all penetrations in subfloor
- Use foundation water management tactics
- Install drain or sump

Unvented Crawlspace

- Less insulation
- Ducts and pipes in heated space
- "Rat" slab
- ICF walls

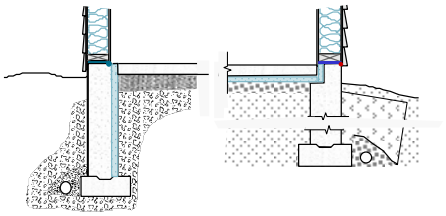
Insulating Concrete Forms



From EEBA Cold Climate Builder's Guide, Fig 6.1

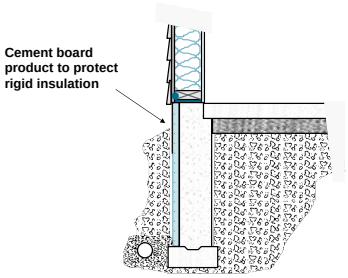
Typical ICF Construction

Slab Edge: Interior Insulation



Slab Insulation

Slab Edge: Exterior Insulation



Exterior Foundation Insulation

Exterior Foundation Insulation

Framing

ENERGY STAR® Requirements

- The Northwest **ENERGY STAR®** homes program allows Advanced Framing options, check with your local Builder Outreach contact for more information…

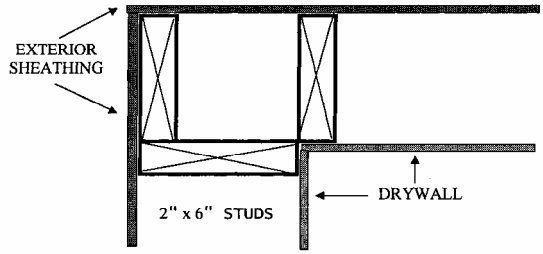
Framing for Energy Efficiency

- Ensures that all framing cavities can be insulated properly
- Allows for increasing insulation in commonly under-insulated areas
- Increase overall R-value by reducing amount of framing material used
- Incorporates air-sealing techniques

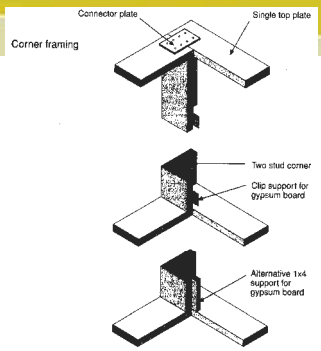
Insulating Steel-Framed Walls

- Steel frame is good heat conductor
  - Narrow section but large surface area
- Tests conducted by AISI / NAHB
  - 6" fiberglass @ 24 o.c. = R 10.1
  - Perfect installation
- ENERGY STAR® analysis:
  - 6" fiberglass @ 16 o.c. = R 7.2
  - Typical installation

Traditional Exterior Corner

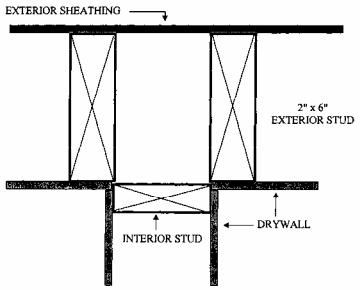


Alternate Exterior Corner

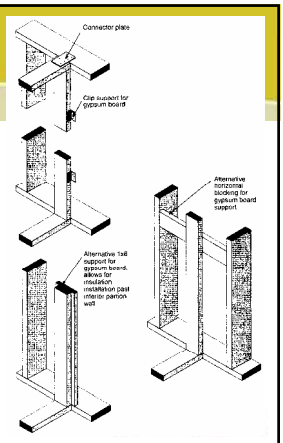


From EEBA Cold Climate Builder's Guide, Fig 5.3

Traditional Interior/Exterior Wall Intersection



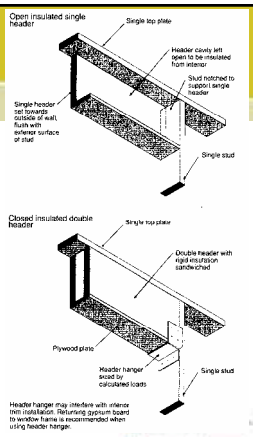
Alternate Interior/ Exterior Wall Intersection



From EEBA Cold Climate Builder's Guide, Fig 5.4

Headers

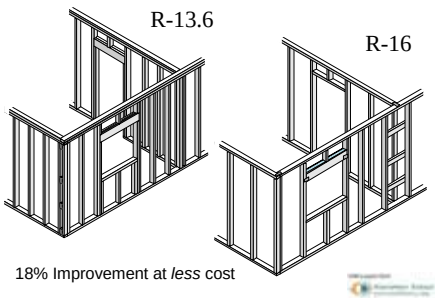
- Eliminate solid wood headers in non load bearing walls
- Insulate headers in bearing walls



From EEBA Cold Climate Builder's Guide, Fig 5.5

Insulated Header

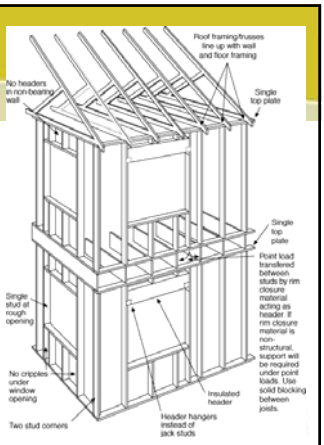
Reducing Framing Material



18% Improvement at *less* cost

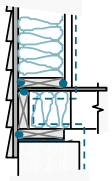
Double 2x12: Holding up 3 cripples and 12 sq ft of plywood…

in a gable end wall

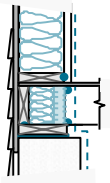


Other Ideas…

Sealing Leaks – Foundation/sill:

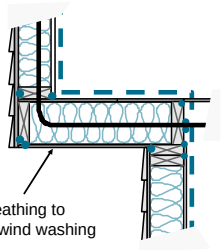


Sealing during framing



After framing

Cantilevered Floor

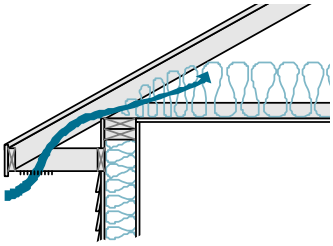


Seal sheathing to prevent wind washing

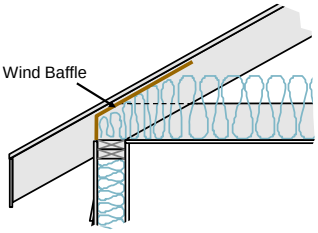
Sealing Framing Leaks

Correct Detail

Truss / Wall Plate Connection



Rafter / Wall Plate Connection



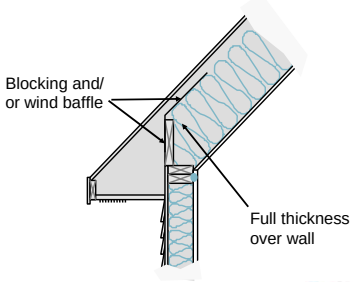
Eave baffles

Pre-cut for 16 o.c. or 24 o.c.
Staple in place fast
Help prevent wind washing
Prevent filling of soffit area
No need for "propa-vents"

Rigid Foam as Baffle / Vent

Spray Foam at Eaves

Cathedral Ceilings



Windows

"Insulating Glass"

- This name is commonly applied to double glazing
  - Approximately R-2
- > 5 times the heat loss as the worst wall anyone is likely to build today (R-11)

ENERGY STAR® Requirements

- BOP 1 Windows must have U-Value of 0.35 or lower
- BOP 2 Windows must have a U-Value of 0.30 or lower
- Sky Lights 0.50 (no more than 5% of conditioned floor area)
- Window and skylight total area can not exceed 21% of conditioned floor area
- 1% of glazing is exempt…Decorative glass

Basic Glazing Types

- Single
- Double
- Low-e
- Gas fills (argon, krypton)
- Heat mirror (extra low-e films)

NFRC Label

Window Surface Temperature

Glass surface temperature at 25°F outdoor, 70°F indoor temperature:

• Single glass	52 °F
• Double glass	59 °F
• Low E + Argon	62 °F
• High performance (Heat mirror films)	64 °F

Window Ideas

- Low-E cuts cooling loads
  - Save money on A/C installation
  - "Southern" low-e for large East & West glass
- Use lower U-values for largest units
  - "biggest bang for buck" for ENERGY STAR, and code compliance
  - Improves comfort

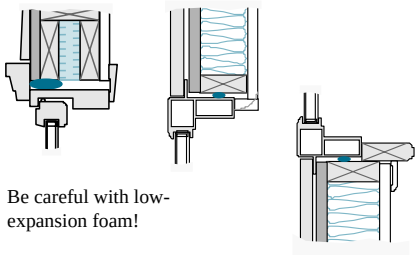
Window Trends

- Warm edge" spacers
- Fiberglass frames

Photo © Kevin Kennefick 2001

Another idea…..

Sealing Around Windows



Be careful with low-expansion foam!

Air Sealing

What is air sealing?

Energy efficiency?

Fire Safety?

Energy Code Corner

402.4 Air leakage (IECC 2004)

- **Building Thermal Envelope.** The building thermal Envelope shall be durably sealed to limit infiltration…The *following* shall be caulked, gasketed, weather-stripped, or otherwise sealed with an air barrier material, suitable film or solid material:

1. All joints, seams and penetrations

How many joints, seams and penetration in this building?

The rest of the list…

2. Site-built windows, doors and skylights
3. Openings between window and door assemblies and their respective jambs and framing
4. Utility penetrations
5. Dropped ceilings or chases adjacent to the thermal envelope
6. Knee walls
7. Walls and ceilings separating a garage from a conditioned space
8. Behind tubs and showers on exterior walls
9. Common walls between dwelling units

AND…

The number 10 place to seal up…

10. Other sources of infiltration!

ENERGY STAR **Requirements**

- Northwest ENERGY STAR defers to code requirements for sealing of penetrations in the building envelope and ventilation requirements.
- Some utility programs may require Blower Door testing and/or mechanical ventilation for incentive eligibility.

Blower Door Test

- Depressurizes house
- Measures air leakage
  - Air Changes per Hour (ACH)
  - Code ACH 0.40
  - Energy Star 0.35
- Finds leaks

Air Leaks

- 30% of heat loss in “typical” home
- Transport moisture
- Reduce comfort
- Increase indoor pollution
- Largest cause of ice dams

Air leaks move moisture vapor into walls and attics

Air leaks are largest cause of ice dams

…and pipe freezing problems

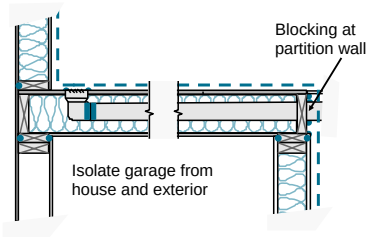
Where Does Air Leak?

At transitions between building surfaces

- Where one material meets another
- Where walls/floors/roof lines meet
- Where empty spaces are hidden by drywall

Insulation DOES NOT stop AIR leaks!!!

Tuck-Under Garage



3606.2.7 Firestopping: Firestopping shall be provided to cut off all concealed draft openings (both vertical and horizontal) and to form an effective fire barrier between stories, and between a top story and the roof space. Firestopping shall be provided in wood-frame construction in the following locations.

1. In concealed spaces of stud walls and partitions, including furred spaces, at the ceiling and floor level;
2. At all interconnections between concealed vertical and horizontal spaces such as occur at soffits, drop ceilings, cove ceilings, etc.;
3. *In concealed spaces between stair stringers at* the top and bottom of the run;
4. At openings around vents, pipes, ducts, chimneys and fireplaces at ceiling and floor level, with noncombustible materials.

780 CMR - Sixth Edition 535
9/19/97 (Effective 2/28/97) - corrected

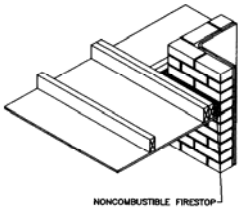


FIGURE 602.7i FIRESTOPPING — AROUND CHIMNEYS AND FIREPLACES

Source: Application and Commentary
CABO One and Two Family Dwelling Code 1995 Editic

Electrical wiring blamed for fire on North Street

"The wood stove pipes were boxed into the interior wall system, *which is what we call a 'chase,'* " McGowan explained. "The chase drew the fire straight up into the attic. The building suffered heavy damage in the attic and roof assembly and in the second-floor bath*room. There was heavy smoke and*

wood stove pipe from the basement to the attic.

"The wood stove pipes were boxed into the interior wall system, which is what we call a 'chase,'" McGowan explained. "The chase drew the fire straight up into the attic. The building suffered heavy damage in the attic and roof assem-

"I want to give the firefighters credit for the tremendous physical exertion they put in to save what was saved there," McGowan said. "Usually in a fire of that type, there wouldn't be anything left standing. I also want to thank the teams from Pownal, Bennington, and Hancock for all their assistance."

Good Job!

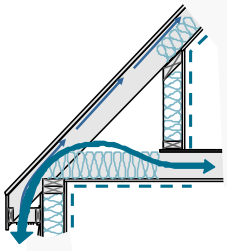
Oops!

Other Big Leaks

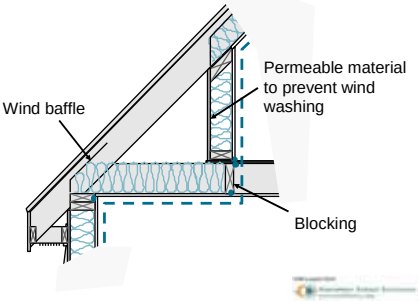
Penetrations

Seal Penetrations

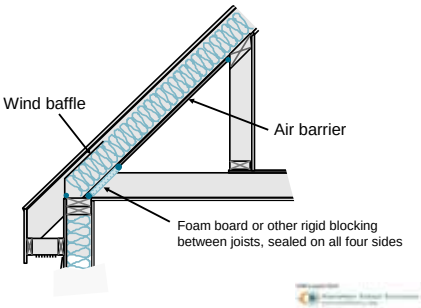
Knee Wall



Knee Wall Solution



Knee Wall Alternate



Advanced Building Systems

Type	Est. ACH nat
Target	.35
Frame - spot sealing	.35 - .25
Frame - spray foam	.20 - .10
SIPS	.25 - .15?
ICF	.15 - .10
AAC	.15 - .10?

Blower Door Test

Pass the test!

But a House Needs to Breathe!

- People need to breathe
  - Fresh air ventilation
- Random leakage = DRAFTS
- Ventilation replaces drafts
  - Little, if any, energy penalty

Buildings Dry Out

- Vapor diffusion
- Air movement NOT needed
- Air movement can cause more problems than it solves
- Fresh air ventilation